

# Match the Graph

## Concepts

- Examine rate of change
- Analyze and interpret the graph of a function

## Materials

- TI-84 Plus
- CBR 2™  
(Calculator-Based Ranger 2™)
- Vernier® EasyData™ Application

## Overview

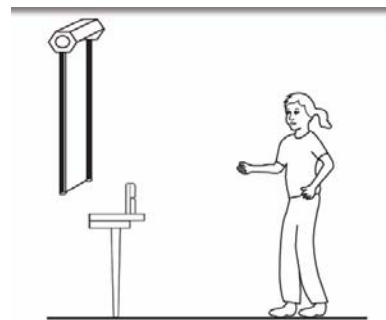
Participants will work in groups to gain experience using the CBR 2™ and EasyData™ APP as they practice walking to match a distance/time graph..

## Introduction

1. Have several students do the *Match the Graph* activity in the front of the class as a demonstration before having students work in their own groups.
2. The room should be set up with an aisle down the middle.
3. Set up a CBR 2™, and point it down the aisle.
4. Connect it to a TI ViewScreen™ calculator so the class can see both the participant walking down the aisle and the data projected from the TI-84 Plus.

## Setup

1. Set up the activity as shown in Figure 1.
2. Link the CBR 2™ motion detector directly to the TI-84 Plus.
  - You can use either the I/O Unit-to-Unit cable or the mini-USB cable.
3. The EasyData™ APP will launch automatically if the mini-USB cable is used.
  - If you are using the I/O unit-to-unit cable, you will need to press the **[APPS]** key, scroll down to highlight the EasyData™ APP, and press **[ENTER]** to launch the application.



**Figure 1**

4. Press  $\boxed{Y=}$  to access the **File** menu, and select **1:New**.
  - This resets the program and clears out old data.
  - In general, the “soft keys” at the bottom of the screen are accessed by pressing the top row of keys on the calculator (Figure 2).
5. The default unit of measurement on the EasyData™ APP is meters. This activity will be done in feet.
  - To change the units of measurement, select the **Setup** menu soft key by pressing  $\boxed{\text{WINDOW}}$  on the top row of the calculator (Figure 2).
  - From the Setup menu, choose 1:Dist by pressing  $\boxed{1}$  or  $\boxed{\text{ENTER}}$  since 1 is highlighted (Figure 3).
6. From the Units menu, select **2:(ft)** by pressing  $\boxed{2}$ , or scroll down until the  $\boxed{2}$  is highlighted and press  $\boxed{\text{ENTER}}$ . Then select OK (Figure 4).

### Data Collection

1. You will be returned to the main screen of the EasyData™ APP. The APP senses the CBR 2™ and starts giving a distance reading across the top of the screen.
  - Select **Setup**, and choose **3:Distance Match** (Figure 5).
2. Select **Start** (by pressing  $\boxed{\text{ZOOM}}$ ), and follow the instructions on the screen.
  - **Distance Match** automatically takes care of the settings (Figure 6).
  -
3. Select **Next** (by pressing  $\boxed{\text{ZOOM}}$ ) to display the graph that is to be matched for this activity.
  - Take a moment to study the graph with your students.
  - Have them answer questions 1–5 on their worksheet (Figure 7).



Figure 2



Figure 3



Figure 4



Figure 5

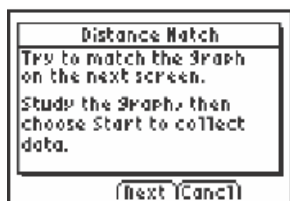


Figure 6

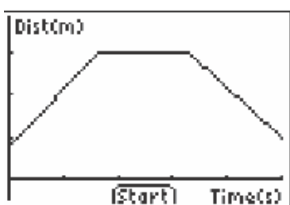


Figure 7

4. Select **Start** to begin the activity.
  - As the walker starts to move, a trace of the walker's path will be displayed in real time along with the original graph (Figure 8).
5. Choose a student or two to do a brief demo of the graph match application for the entire class.
  - Select **Retry** to display the same graph again, and select **New** to display a new graph.
  - Take a moment to study one of the walks.
  - Have students answer questions 6–9 on their worksheets (Figure 8).
6. Outline the directions to be used for this activity.
  - Students earn up to five points in each of five areas: starting point, direction, rate, deviation, and teamwork.
  - “Starting point” points are earned for being close to the actual starting point.
  - In the “Direction” section, students earn points by going the correct direction.
  - “Rate” points are earned for walking the same rate as that in the graph, resulting in the same or parallel lines.
  - Students get “Overall Fit” points for not deviating from the graph.
  - For working as a team and helping the walker, the students earn “Teamwork” points.
7. If you have enough CBR 2™ units, allow students to practice with their group for 5–10 minutes.
  - An alternative setup is to have the student hold the calculator and CBR 2™ while pointing the CBR 2™ at the wall as shown in Figure 9.
  - Students should take turns in their groups having each participant gain experience using the CBR 2™ and in walking to match the graph.
8. If you only have one CBR 2™, have one student from each group take a practice “walk” in front of the entire class while their progress is viewed on the overhead. Their team members may offer advice.

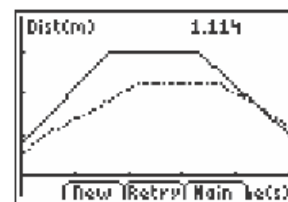


Figure 8

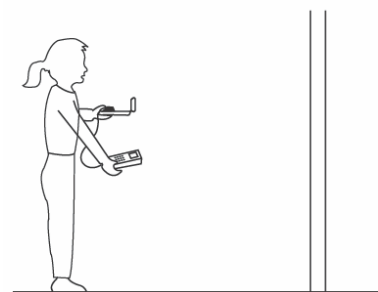


Figure 9

9. After the practice “walk,” randomly pick a team to match a graph. Then follow with the other teams in succession.
  - For example, if you randomly pick team 4, the teams will follow in this order: 5, 6, 1, 2, 3, 4.
  - Let the first team make a second attempt at the end.
  - Give each team one minute or less to discuss the match.
10. Solicit scores for the group by a show of hands.
  - Record the score given by most students rather than trying to average the scores.
  - Let each student use the table on the worksheet to keep track of the scores.

### Worksheet Answers

1. Time
2. Seconds, 1 second
3. Distance
4. Could be feet or meters, depending on your settings; 1 foot or 1 meter
5. Depends on first graph that is displayed for the class demo
6. Depends on first graph that is displayed for the class demo
7. Backward. If the line slopes up, as the **X**-values (time) increase, so must the distances from the CBR 2™ represented by the change in the **Y**-values. To increase these distances the walker needs to move farther away.
8. Forward. If the line slopes down, as the **X**-values (time) increase, the distances from the CBR 2™ represented by the change in the **Y**-values must decrease. To decrease these distances the walker needs to move closer to the CBR 2™.
9. Stand still. If the line is flat, the slope is zero. This means that as the time increases the distances remain the same.

## Match the Graph

Student Worksheet

Name \_\_\_\_\_

Class \_\_\_\_\_

### Objectives

- Examine the rate of change
- Analyze and interpret the graph of a function

1. What physical property is represented along the **X**-axis?
2. What are the units? How far apart are the tick marks?
3. What physical property is represented along the **Y**-axis?
4. What are the units? How far apart are the tick marks?
5. For the first sample graph your teacher displays, how far from the CBR 2 motion detector do you think the walker should stand to begin?
6. Did the walker begin too close, too far, or just right?
7. Should you walk forward or backward for a segment that slopes up? Why?
8. Should you walk forward or backward for a segment that slopes down? Why?
9. What should you do for a segment that is flat? Why?

**Scoring Directions for Graph Match**

Give each team a score from 1–5 based on the following criteria.  
(1 is lowest, 5 is highest.)

|                | <b>Starting Point</b> | <b>Direction</b> | <b>Rate</b> | <b>Overall Fit</b> | <b>Team Work</b> | <b>Total</b> |
|----------------|-----------------------|------------------|-------------|--------------------|------------------|--------------|
| <b>Group 1</b> |                       |                  |             |                    |                  |              |
| <b>Group 2</b> |                       |                  |             |                    |                  |              |
| <b>Group 3</b> |                       |                  |             |                    |                  |              |
| <b>Group 4</b> |                       |                  |             |                    |                  |              |
| <b>Group 5</b> |                       |                  |             |                    |                  |              |
| <b>Group 6</b> |                       |                  |             |                    |                  |              |